Pico Solar PV for remote homes

Erik Lysen
Former Chairman Executive Committee IEA-PVPS

ACE Rural Electrification Workshop
Yangon, Myanmar, 4-5 April 2013

IEA-PVPS programme

- **International Energy Agency:** founded in response to 1973 oil crisis, based in Paris (*www.iea.org*)
- First: focus on oil, but soon: how to reduce consumption and develop renewable sources
- **IEA-PVPS:** established in 1993 (*www.iea-pvps.org*)
- **Global expertise** on both large and small PV, quality, performance, policies, financing, etc.
- **Method**: joint research, publications, workshops
- **Organisation**: work done in several ‘Tasks’.

Task 9: Deploying PV Services for Regional Development

Millenium Development Goals related	4 - Integration of PV in energy systems:
1 - PV Water pumping 2 - PV and Health, community services 3 - Pico PV Services	▪ Hybrids for rural electrification. ▪ PV in urban settings ▪ Very Large Scale systems

5- Innovative business models (included in ST 1-4)

6 - Deployment and outreach:

- **Asia**: Asian Development Bank, ASEAN Center for Energy
- **Africa**: CLUB-ER, Alliance for Rural Electrification,
- African Development Bank, IRENA

PVPS

Clients and rural electricity

- Clients have generally no interest in PV system or in electricity per se, but in the **service** that electricity can deliver.
- They want: light in the night, recharge a mobile phone, iron clothes, watch TV, etc.
- Difference between a 1000 watt iron and a one watt radio seems obvious for engineers, but for most people it is simply irrelevant.
- Therefore they prefer the grid: more energy per day and higher peak power allowed

Pre-electrification: “solar trap”

- Message pre-electrification: “solar systems are temporary, grid will come soon”
- Reality: grid arrives much later, or never (first example: Pattiyapola, Sri Lanka, 1975)
- So-called “solar trap” should be avoided
- Clients with pico solar PV systems, despite the provision of an initial level of service, should still be considered non-electrified

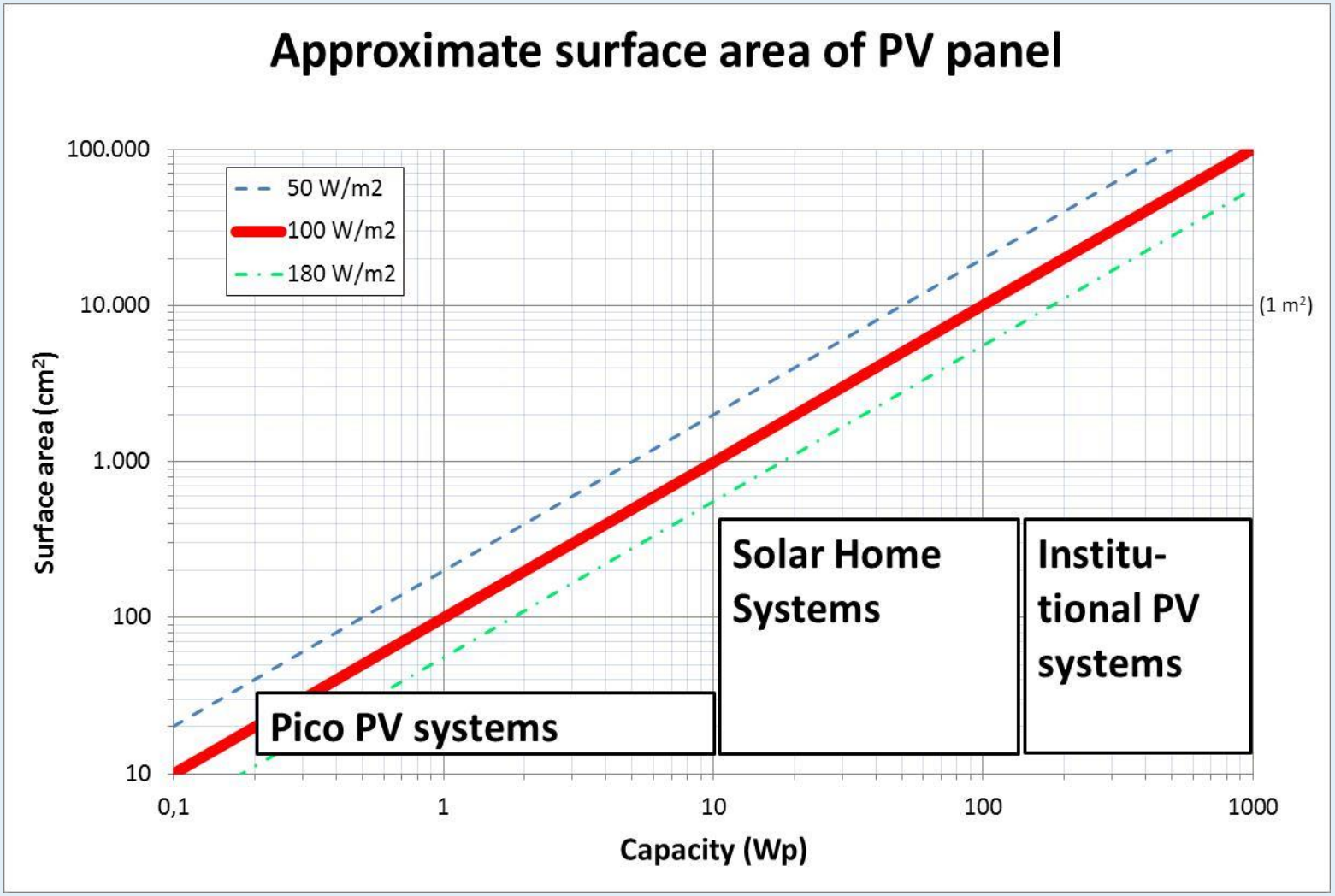
Solar lanterns

- Mid 1990s: variety of **solar lanterns** on market (equipped with CFL, later LED)
- Laboratory tests of early lanterns (Fraunhofer ISE):
  - Poor mechanical design and workmanship,
  - missing over-current protection of the LED,
  - poor electrical design,
  - insufficient light output,
  - defective protection of the battery and ballast
- Rapid turnover, new products every month, quality gradually improving

Reference: Reiche, Kilian, et al. *What difference can a Pico PV system make?*, GTZ, Eschborn, Germany, May 2010

What are Pico Solar PV systems?

Pico PV: panel capacity and size?



Key services small PV systems

- Lighting, phone charging, radio, TV
- **Lighting** rural household: min. 300 lumen
  - Traditional: 30 watt incandescent lamp
  - Now: three LED lamps of 1 watt
- New generation of pico PV systems:
  - Better LED technology
  - Better electronics
  - Better batteries
  - Advantage of modularity.

Energy demand key services

Load	Type of service	nr	watt	hr/day	Wh/day
study light	50 lumen	1	0.5	3	1.5
main light	200 lumen	1	2.0	2	4.0
night light	10 lumen	1	0.1	8	0.8
phone	charging (50%)	1	2.0	1	2.0
radio	sound	1	0.5	2	1.0
TOTAL					**9.3**

- Simple mobile phones: battery capacities of 700 to 1000 mAh. With lithium-ion (3.7 V) this equals 2.6 to 3.7 Wh. Charging efficiency 90%: about 3 to 4 Wh for full charge (smart phones: more)
- Small TV (LCD): 30 Wh/day
- Fans: 300 Wh/day
- Refrigerator (new vs old): 300 vs 3000 Wh/day

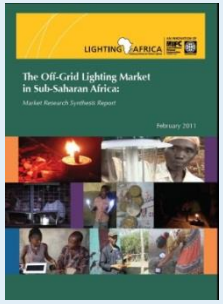
Energy supply of PV system

- Fixed system in tropics: up to 5 Wh/day per Wp (N-Europe: 2.5 Wh/day)
- Portable system in tropics: 3 Wh/day
- With storage efficiency: **2.5 Wh/day**
- Conclusion: demand of 10 Wh/day can be supplied by PV panel of 4 Wp

Manufacturers (mainly solar lanterns)

Company (nr. approved products, Lighting Africa, Aug 2012)	
Barefoot Power (3)	Schneider Electric (3)
Betta Lights (2)	Solux (1)
D-light (3)	Sunnight (2)
Greenlight Planet (2)	Suntransfer (1)
Lemnis Solar (1)	SunSumSolar (1)
NIMH Technologies Foce (1)	Sunlite Solar (1)
Nokero (1)	Toughstuff (2)
Nuru (1)	Trony Solar (2)
Philips (1)	Uniglobe (1)
Prakruthi Power (1)	

From website www.lightingafrica.org in alphabetical order



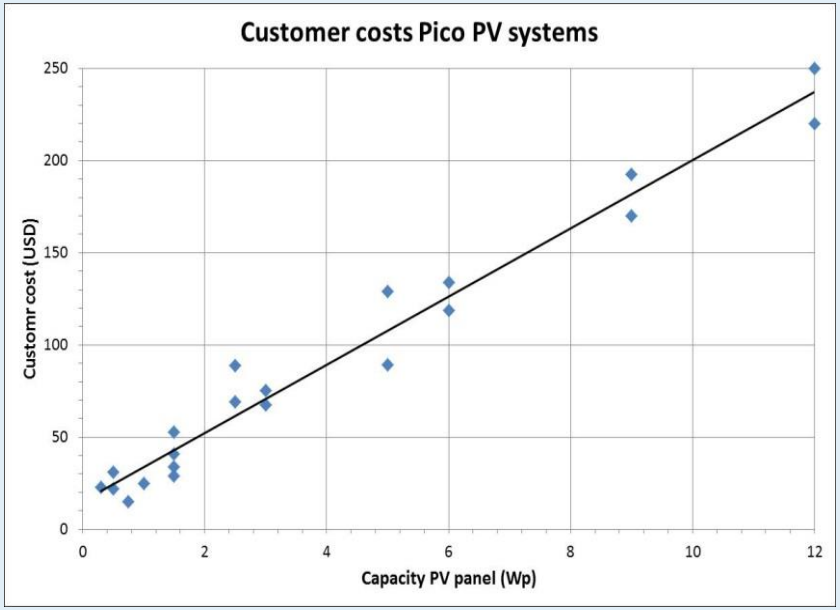
Lighting Africa (IFC, WorldBank)

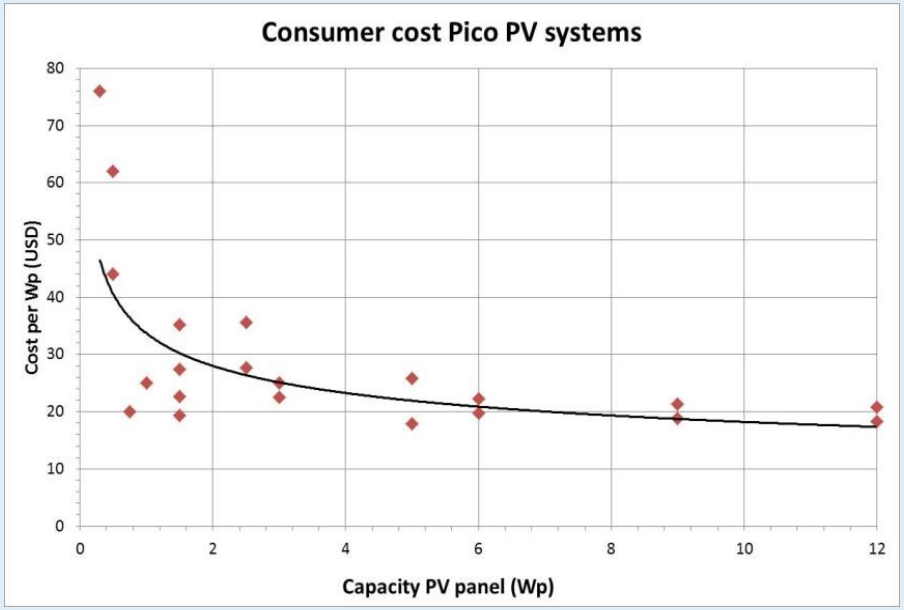
- LA programme covers: rigorous testing, publishing approved products, training technicians, helping private sector with removing barriers (www.lightingafrica.org)
- Preferences of the users: system should give a bright light, be affordable, multipurpose: lighting 2 rooms, phone charging, portable, easy to use, safe and secure, have a long battery life.
- Lighting Asia/India programme launched (mid 2012)

Typical Pico Solar PV systems

Source	Battery type	Battery	PV panel	Cap. Ratio
Pico PV systems		Wh	Wp	Wh/Wp
Fosera: Scandle 75	lithium-ion	2.6	0.5	5.2
WakaWaka	NiMH	2.9	0.75	3.8
Barefoot: Firefly Mobile Lamp	Lithium Iron Phosphate	2.8	1.5	1.9
Barefoot: Firefly Mobile Ultra Torch	Lithium Iron Phosphate	5.6	1.5	3.7
Fosera: PSHS 2800	lithium-ion	9.0	1.5	6.0
Barefoot: PowaPack Junior Matrix	Lithium Iron Phosphate	12.2	2.5	4.9
Sundaya: Ulitium 200	lithium-ion	16.7	3.0	5.6
Bettalights: BettaOne	Lead crystal (SLA)	24.0	3.0	8.0
Fosera: PSHS 7000	lithium-ion	22.4	5.0	4.5
Bettalights: BettaTwo	Lead crystal (SLA)	24.0	5.0	4.8
Barefoot: PowaPack 5W Bright	Lead Acid	60.0	5.0	12.0
Bettalights: BettaTwo Plus	Lead crystal (SLA)	72.0	10.0	7.2
Barefoot: PowaPack Village Kit 10W	Lead Acid	204.0	10.0	20.4
larger PV systems				
DEEP-EA: Solar Charging station	Lead Acid	312.0	14.0	22.3
Free Energy Europe: solar TV	Lead Acid	360.0	14.0	25.7
DEEP-EA: Solar Charging station	Lead Acid	1200.0	50.0	24.0
DEEP-EA: Solar Charging station	Lead Acid	1560.0	75.0	20.8
R&S: Sukatani Solar Home System (1988)	Lead Acid	1200.0	80.0	15.0
Free Energy Europe: solar fridge	Lead Acid	2640.0	112.0	23.6

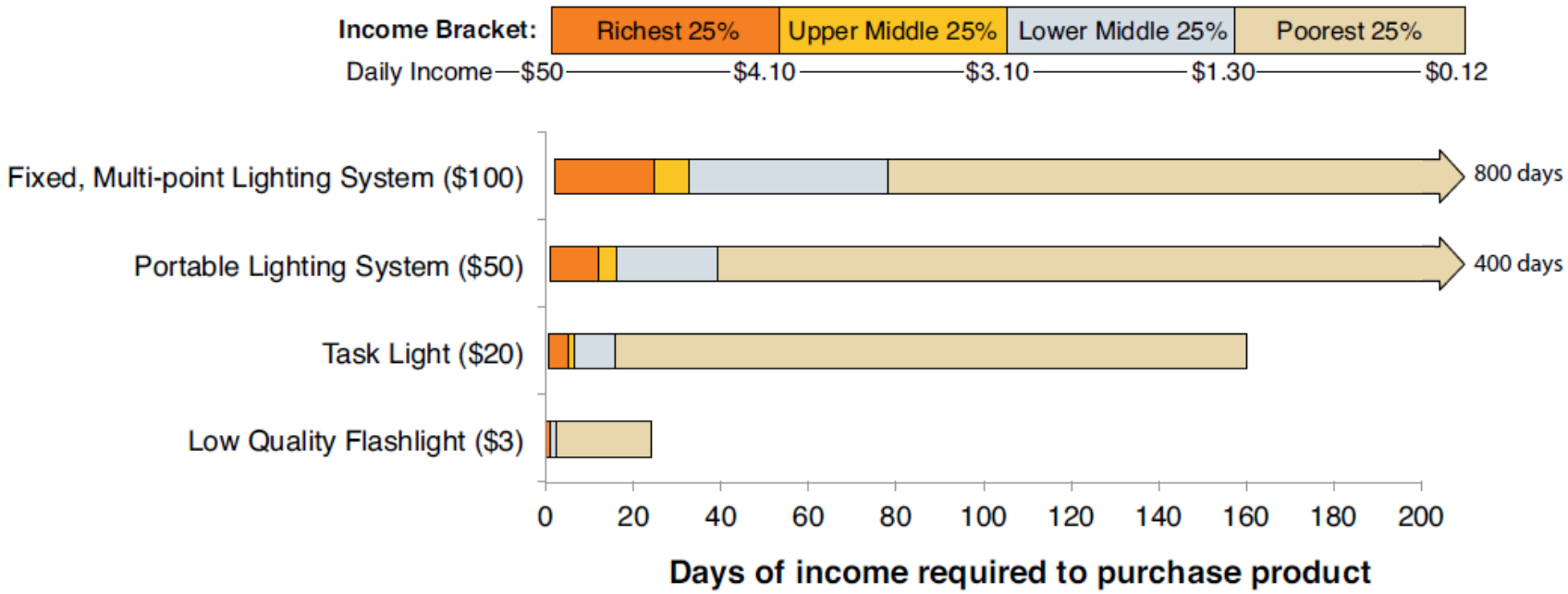
Costs of pico PV systems





PVPS

Willingness to pay



Reference: Alstone, Peter, et al, *Expanding Women's role in Africa's Modern Off-Grid Lighting Market.* Lighting Africa programme, IFC and World Bank, Washington D.C., USA, October 2011.

Business models

1. **Commercially** led approaches, in which suppliers and dealers develop the market (typically relying on cash sales)
2. **Credit sales** programmes, managed by variety of stakeholders (dealer credit, end-user credit, or lease/ hire purchase)
3. **Utility models** (often, but not exclusively, with fee-for-service payment)
4. **Grant-based models** (typically used for institutions, highly managed and structured)

Links with mobile phone market

- Cost comparable
  - Simple phones: USD 30-50
  - Simple pico PV systems: same
- Regular charging needed
  - Charging in remote areas not easy
  - Solar charging logical step
- Payment via the phone itself
  - M-PESA (Mobile Money) popular in Kenya
  - IndiGo technology with scratch cards

Role of key market actors

Market actor:	What to do	What NOT to do
Governments	Provide and disseminate reliable information: pros & cons	Interfering with market by direct subsidies
	Establish and support a fully transparent QA scheme	Reduce subsidies for kerosene etc.
	Link QA products to soft loans	Considering an area covered by pico PV systems as electrified
Finance sector	Provide micro-credit to QA products	Administration of micro-credit (transaction costs will be too high)
	Accept pico PV as collateral via retailers	
Certification institutes	Simple test-labeling QA scheme including follow up testing	Introducing non-tariff trading barriers by certification procedures
Commercial/retailers	Try to establish industry associations with code of conduct	Pushing people working in the informal sector out of business, without giving them a genuine chance to become formal sector members
Customers	Ask the dealer for a guarantee period of the product	Taking micro-credit where the payback period is longer than the lifespan of the product
Donors	Support all the above measures via capacity building and funding	Subsidizing hardware
		Considering this the means to achieve electrification goals

Role of governments

Facilitating role, not interfering with the market:

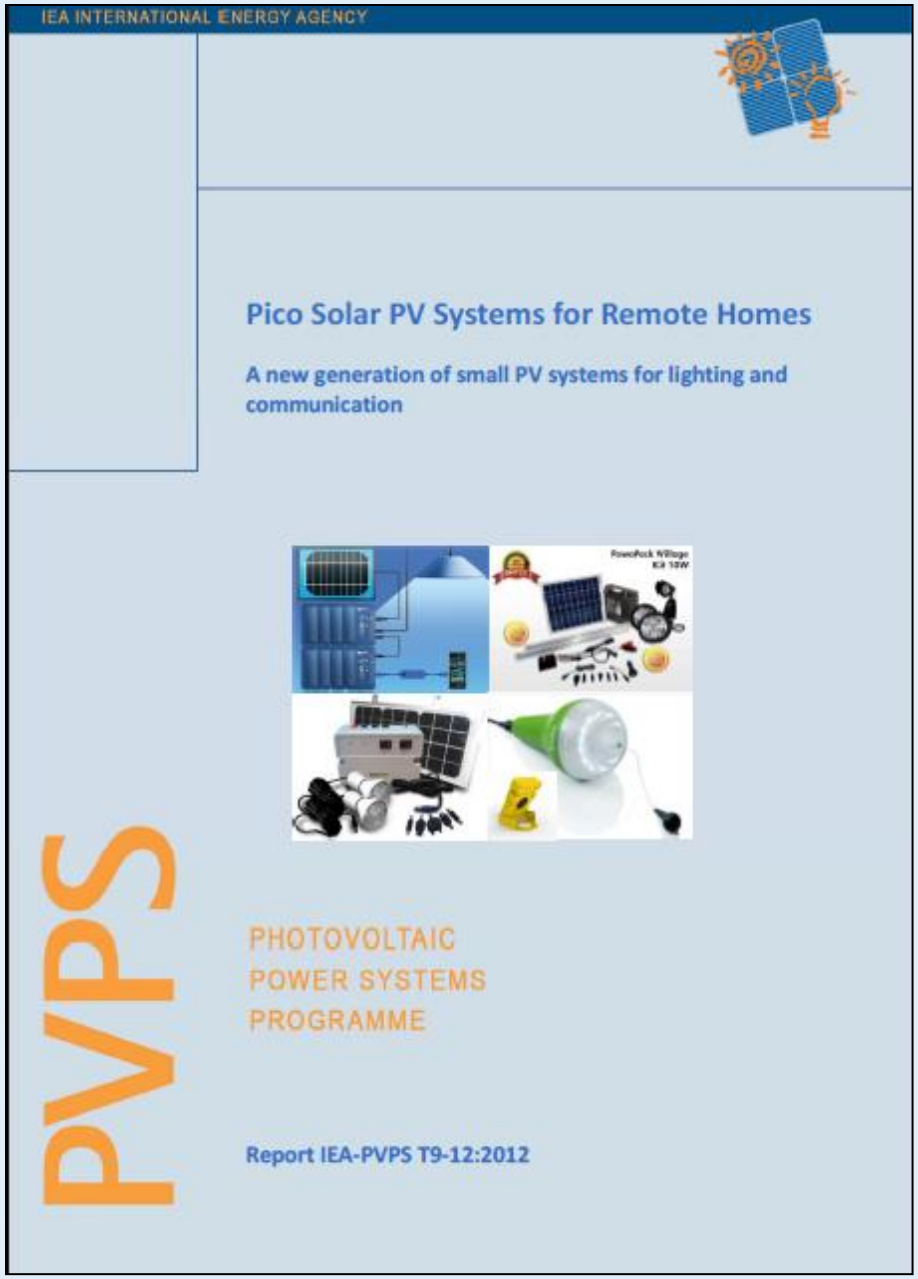
- Quality assurance scheme for products in market
- Providing and disseminating reliable information about products
- Education of consumers about costs and quality
- No subsidies to products
- Gradual reduction of kerosene subsidies
- Guarantees for micro credit schemes

Role of donors

Donors can play indirect role:

- funding programmes to educate target groups
- helping to guarantee a minimum quality level of the systems
- supporting micro-credits
- avoiding to subsidize equipment
- not interfering with the market

But: neither donors nor governments should consider pico solar PV systems as a substitute for full rural electrification



IEA-PVPS Task 9 Report:

Pico Solar PV systems for Remote Homes

A new generation of small PV systems for lighting and communication

At: www.iea-pvps.org

THANK YOU

for your attention